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Thumbnail images: uncertainties, infrastructures and search engines

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ABSTRACT

This article argues that thumbnail images are infrastructural images that raise issues of uncertainty in two distinct, but interrelated, areas: a legal question of how to define, understand and govern visual information infrastructures, in particular image search systems in epistemological and strategic terms; and a cultural question of how human–computer interaction design works with navigational uncertainty, both as an experience to be managed and a resource to be exploited. This paper considers two copyright infringement cases that involved search engines as defendants, *Kelly v. Arriba Soft* (2003) and *Perfect 10, Inc. v. Amazon.com, Inc. and A9.com Inc. and Google Inc* (2007). The cases are revealing of the issues that arise when thinking about thumbnails as infrastructural images in relation to uncertainty. Legal research on thumbnail images has focused on fitting them into the framework of copyright—which precedes digital technology. This article revolves around the infrastructuring of thumbnail images in a medial sense: as infrastructures of logistics and desire. The article draws on infrastructure studies, feminist visual and human computer interaction (HCI) theory and legal theory to examine how the thumbnail has been negotiated in legal terms, its cultural infrastructures, and the information behaviours they are designed to produce.

KEYWORDS

Thumbnail images; image search; digital culture; infrastructures; copyright

Introduction

On 16 May 2007, Reuters ran a story under the title: ‘Tiny sex images get OK from court’. The article announced that the US 9th Circuit Court of Appeals lifted a preliminary injunction against Google over showing thumbnail images, which were a central element of their image search engine service. The injunction occurred in February 2006, when a lower court ruled in favour of the adult media house Perfect10, which claimed that Google violated copyright law by displaying thumbnails of images from Perfect10’s website (see [Figure 1](#)).

An injunction against showing thumbnails was granted but later vacated. In overturning the

ruling, Reuters, in a report from 16 May 2007, cited the appellate court’s decision: ‘We conclude that Perfect10 is unlikely to be able to overcome Google’s fair use defense and, accordingly, we vacate the preliminary injunction regarding Google’s use of thumbnail images.’

The ruling enabled Google—then still known to most as a text-based search engine—to maintain and expand their technology infrastructures to what most users today practice habitually as image search. Until then, image search had been a budding infrastructural field of research and an experimental industry with few and minor players in the field such as the early general search engines AltaVista, Lycos



Figure 1. Perfect10. (Internet Archive; accessed August 16, 2017). <https://web.archive.org/web/20070516163348/http://www.perfect10.com/>.

and later Google Image Search and Yahoo! Picture Gallery as well as the specialized image search engines such as WebSEEK, Ditto, Ithaki and Picsearch.

One of the major obstacles to the development of image search in the early years was the issue of copyright. Most websites stridently declare that the images residing on their pages are illegal to copy without authorization. Yet, to perform an image search, search engines would have to copy images per default, albeit in lower resolution.

This paper focuses on the negotiations of thumbnail images as an emblematic illustration of the air of uncertainty that enshrouds thumbnail images. Legal research on thumbnail images has been concerned with questions pertaining to what constitutes an infringing copy in digital environments (Tushnet 2012; Stokes 2014). A second strain of research asks of the indexical relation of photographic images and what the status of algorithmic images is in indexical terms (Gunning 2004; Doane 2007; Lister 2007; Soderman 2007; Hoelzl and Marie

2015). Both strains inquire into the uncertain epistemology of digital images. These questions are crucial and also inform this article. Yet, the present article takes a different approach. Drawing on infrastructure studies (Star and Strauss 1999; Bowker and Star 2000), legal analysis and feminist visual culture and human computer interaction (HCI) theory (Haraway 1988; D'Ignazio and Klein 2016; Agostinho Forthcoming), this article asks of the kinds of relationships the thumbnail image promises between infrastructural technology (search engines) and users, and the issues of decisional uncertainty these relations are premised on. Search engines are infrastructural technologies par excellence, directing and routing human traffic much like highways and forest paths. Yet, in contrast to traditional infrastructural imaginaries of pure materiality, we stress that their infrastructural dimension exceeds the physical, and often stable, nature of hardware and software to also encompass contingent social infrastructures such as legal arrangements, visual interpretation and desirous

systems. Looking at thumbnail images through the combined lens of law and infrastructure in relation to visual culture and software studies offers a productive approach to understanding the particular epistemological and infrastructural uncertainties embedded in the miniature image.

More specifically, we argue that it came to work to the advantage, both materially and symbolically, of the technical infrastructures of the World Wide Web that the definition of the thumbnail was left in uncertain terms by the law. The very existence of image search infrastructures depends on the defense of fair use, yet the legal decision relies on a highly uncertain description of what actually constitutes a thumbnail image in terms of size, resolution and other distinctive qualities.

Secondly, we argue that thumbnail images themselves thrive on infrastructural uncertainty, offering both promises of increased navigational certainty and possibilities of surrendering oneself to uncertainty through exploration. Indeed, their very existence attests to the productive presence of uncertainty in digital environments, where thumbnails have been invented to ameliorate experiences of information overload by providing the user with visual cues, while also equipping them with a desire to explore further through these ameliorations.

Thumbnails as uncertain infrastructural images

Visual search engines are ecologies of images, software, hardware, law and users, etc. Within these visual ecologies, the thumbnail image has become a dominant navigational vehicle transporting users from one visual point to the next. The thumbnail image has thus in a sense come to signal a site of certainty, offering the user the promise of direction and a wayfaring compass in an increasingly overwhelming visual universe. Yet, while the role of the thumbnail is to instill the user with

certainty, they are also laced with *uncertainties* in terms of both their infrastructural epistemology and their social motivation. Thus, while the discourse on thumbnails often emphasizes rationalized logistics, we find within these discursive formations questions of legal vagueness and visual desire for existential uncertainty.

To understand the uncertainties enshrouding thumbnail images, however, first we must understand its role and function in the World Wide Web. Thumbnail images consist of a set of algorithms executed to provide visual cues that might aid the user in navigating and exploring information-rich environments. They are often compressed versions of pictures or videos, whose compact size reduces loading time. They are used to help the user discover, recognize and organize images, thus serving the same indexical role for visual material as a normal text index does for words (see [Figure 2](#)). Importantly, then, thumbnails used by search engines—where the primary role of the thumbnail image is to point the user elsewhere instead of acting as a destination in itself—reside in a different server than the original image to which it points. This way, the user can orient herself through visual cues on the search engine, but will have to travel to a different server to access the full-scale image.

One of the earliest creators of thumbnail images for this purpose was the company Girafa that developed information visualization services for web developers under the tagline ‘If it caught your eye, then catch it later’ (see [Figures 3 and 4](#)). An important feature for Girafa was the thumbnail’s ability to provide the user with a sense of overview. As Shirli Ran, co-founder and chief operating officer of Girafa, was quoted as saying in an *Information World Review* article in the June 2001 issue: ‘Several of our engineers are avid skydivers. They insist that their best insights form as they hurtle toward the earth at 180 miles per hour in a head on dive.’

While few web users browse the net while hurtling towards the ground, masses of

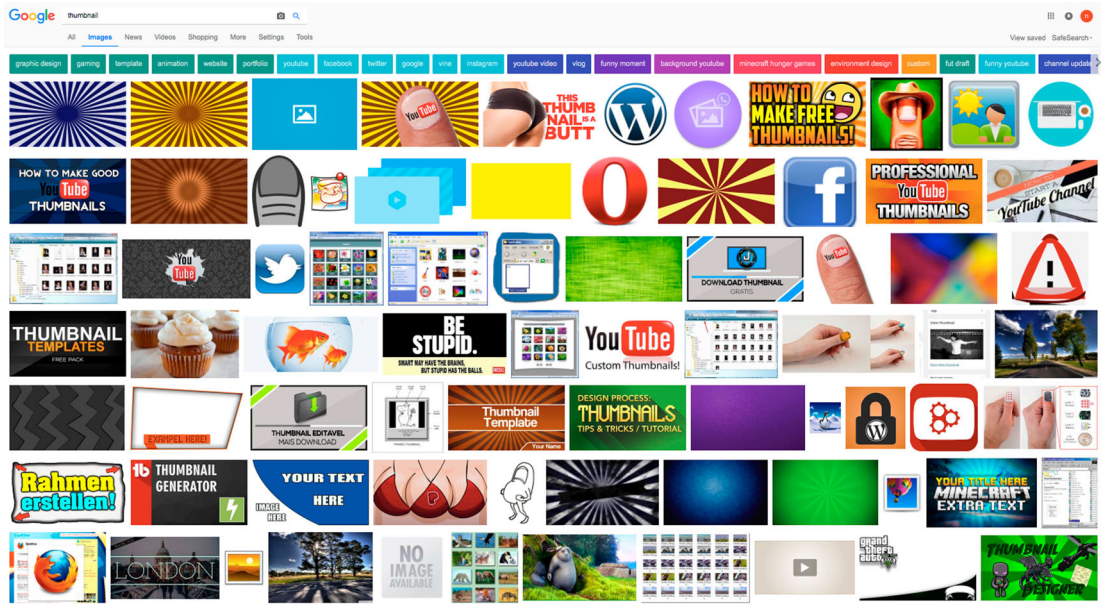


Figure 2. Google Image (author's own image search for 'thumbnail', accessed August 16, 2017).

information online can indeed produce a sense of vertigo (Mitchell 2014). A large number of computerized systems today employ thumbnails to ameliorate exactly this sense of vertigo through visual overview. Thumbnails thus aid user navigation and user memory as well as facilitate efficient file retrieval. Moreover, thumbnails are increasingly used to advertise for the content they represent.

Since the 1990s, image search has become consolidated as one of Google's central features, with Google as the largest provider of image search infrastructure. Google's services crawl the Web for images, and automatically make low-resolution thumbnails of all the images it indexes. Google Image search (as its predecessors) thus does not store the captured images on its own servers, but rather uses inline linking,

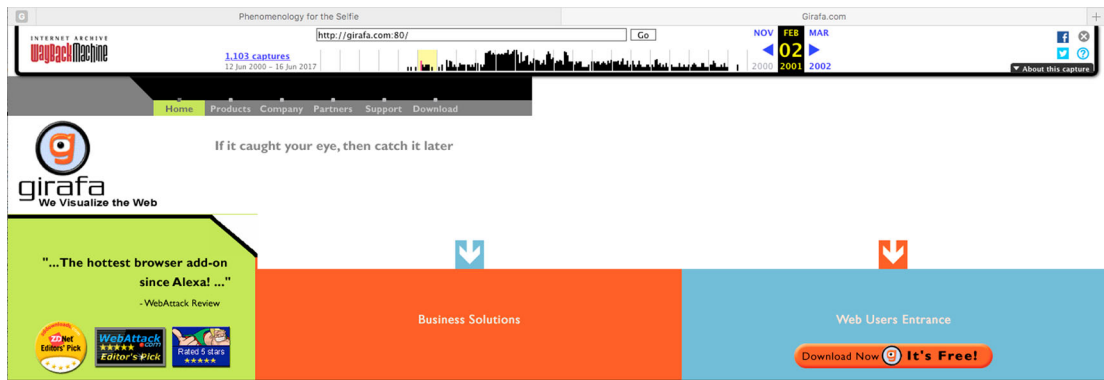


Figure 3. Girafa.com (Internet Archive, February 2, 2001). Accessed August 16, 2017. <https://web.archive.org/web/2001020205800/http://girafa.com/>.

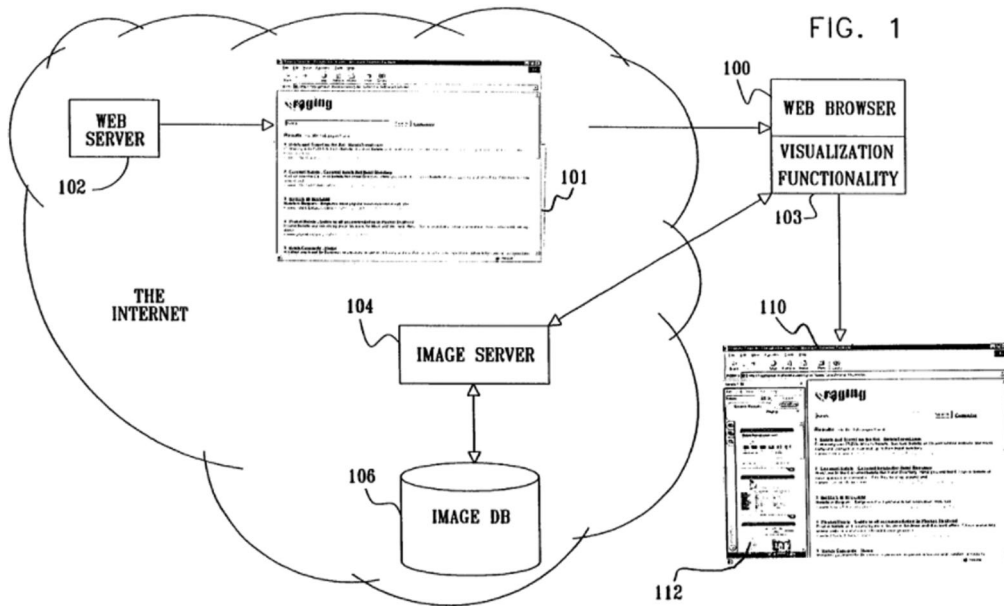


Figure 4. Framework for providing visual context to www hyperlinks, [Figure 1](#). US Patent 6,864,904 B1. Filed November 8 (Ran, Barnoon, and Yarom 2005).

placing the image from a distant website onto the web page being viewed.

The uncertain status of thumbnail images

The apparent incompatibility between the emerging image search infrastructure and the law showed the first public signs of unrest in 1999 in a notable case between photographer Les Kelly and ditto.com (see [Figure 5](#); formerly the Arriba Soft Corporation).¹ Ditto, which searched the Web and indexed its images, successfully defended itself in December 1999 when plaintiff Kelly sued, claiming Ditto was in breach of copyright law when they, without permission, took thumbnails of images and placed them in a searchable database.

Kelly claimed that Ditto supported itself by making money on the work of others by

creating the database of copyrighted work. Yet, the United States District Court decided that Ditto's operations constituted 'fair use' which made it legal according to US copyright law. The reason the court provided was an infrastructural one: the Court emphasized that when an image search engine frames a page or provide an inline link, it is the site that the engine is pointing to that displays the image, not the search engine itself. This argument was informed by the technical understanding on inline linking.

When an inline link of an image is used on a web page, it seems to be present as a part of the viewed web page. The presence of the image is only virtual, however, in the sense that the image file is not physically present at the server for the website being viewed, but rather still resides at the original server (see [Figure 6](#)).



Figure 5. Ditto.com (Internet Archive; accessed August 16, 2017). <https://web.archive.org/web/20000304055633/https://www.ditto.com/>.

The thumbnail image in the court's eyes, in other words, acted as a logistical element pointing elsewhere rather than an image in its own right. Because Arriba did not hold the images on their own server, the court reasoned, users would inevitably have to move to Kelly's website to see the full-size images, stating:

Once the thumbnails are created, the program deletes the full-sized originals from the server. Although a user could copy these thumbnails to his computer or disk, he cannot increase the resolution of the thumbnail; any enlargement would result in a loss of clarity of the image ... Even if users were more interested in the image itself rather than the information on the web page, they would still have to go to Kelly's site to see the full-sized image. The thumbnails would not be a substitute for the full-sized images because the thumbnails lose their clarity when enlarged. (*Kelly v. Arriba Soft Corporation*, 336 F.3d 811 (9th Cir. 2003), 1968)

Significantly, while the court found that US search engines may use thumbnails of images, it did not determine the size limits for what would constitute a thumbnail image; nor did it

resolve the issue of what inline linking to full-size images instead of going to the original site implied in terms of copyright breach. Thus, while Ditto's use of thumbnails was exonerated as fair use, significantly the verdict left the thumbnail with an uncertain conceptual description. As we shall see, a subsequent ruling retained the conceptual uncertainty.

The dictionary is not of much help either. Despite its ubiquity, the conceptual definition of the thumbnail remains loosely defined. The image has not yet gained its own independent article in the Oxford English Dictionary, which still only contains a draft addition in a computational context dating back to 2006, 'A miniaturized version of a document or part of a document; (Computing) a small version of a digital image, freq. acting as a hyperlink to a larger version.' The Dictionary of Computing is not much more helpful defining a thumbnail as 'A small (lower resolution) reproduction of an image or page, used as a link to the image or page in a web site or electronic document' (Oxford English Dictionary Online, 2017).

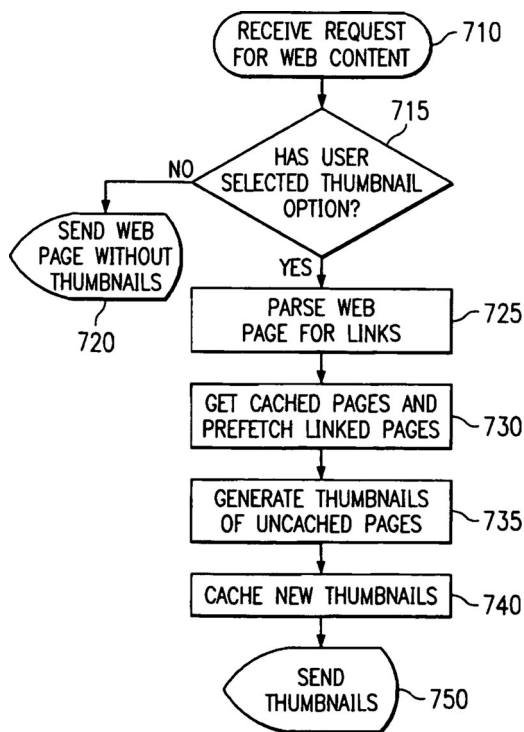


Figure 6. Brown, Lawrence, and Paolini (2003). Web-page thumbnails and user configured complementary information provided from a server, Figure 9. US Patent 6665838 B1, filed July 30.

Thumbnails as infrastructural images

We wish to enrich the conceptual scarcity of the thumbnail image with the suggestion that it is an *infrastructural image*. We argue that thumbnail images are more than just images in reduced size. They are algorithmic images (Hoelzl and Marie 2015) embedded in visual infrastructures of search that have become central to the World Wide Web, facilitating the flow and exchange of images, ideas and goods. They provide informational mediation and relations. As algorithmic and material forms they shape the speed and direction of the network, the temporalities it affords and the visual expressions it takes. They comprise an algorithmic architecture for image circulation, literally undergirding the image search functions that have become increasingly central to the visual turn. Yet, despite their

operational nature, they are also nurtured by, and themselves active producers of, a series of navigational and epistemological uncertainties ranging from uncertain legal interpretation to the titillating uncertainty of losing oneself in the streams of images, uncertain of where one was coming from or where one is headed to. Thumbnail images could thus be understood with Hoelzl and Marie's (2015) as 'operative images', that is, images that are operationalized by databases, but also actively encourage the user to keep exploring and consuming new images and new information. As such they qualify as a crucial infrastructural system in the sense often emphasized by recent infrastructure studies that pay attention to both the practical, social and desirous aspects of infrastructures.

As Paul N. Edwards notes, 'infrastructure' is, given the heterogeneity of the concept, perhaps best defined negatively as 'those systems without which contemporary societies cannot function' (Edwards, 18). If we take search engines to be one of today's central societal backbones, then the thumbnail is a crucial element of these infrastructures. The infrastructures of thumbnail images have developed under the influence of a combination of practical functions, law, human uses and cultural norms. Today, they form a juncture of social organization, moral and legal order, and layers of technical integration that embed historical processes of their material development as tools made for a variety of users and uses, the negotiated compromises about their epistemology and the ways in which they work with other socio-technical infrastructures.

Until recently, the human sciences had little to say about such infrastructural systems, but in recent years the issue of infrastructures has become increasingly central to researchers pre-occupied with media and other forms of socio-technical infrastructures. Indeed, as media theorist John Durham Peters notes, it appears as if structuralism and poststructuralism have

now been superseded by infrastructuralism. By which Peters means that media studies are increasingly concerned with the mundane infrastructures that organize our lives, including media, indeed the infrastructural media that *stand under* (Peters 2015, 42). He unfolds this perspective to point out how media theory increasingly pays interest not only to content and audience, but also to the logistical role of media, and the enabling conditions that are backgrounded from perception (Peters 2015, 43).

The recent interest in infrastructures includes paying attention to the influence of material and cultural infrastructures on culture, as well as the culture of infrastructure building itself. In his review of recent anthropological and related disciplinary work on infrastructures, Brian Larkin (2013, 328) uses the notion of techno-politics to trace a shared analytic concern to 'reveal forms of political rationality' that underlie technological projects and which give rise to an 'apparatus of governmentality'. One example of such an approach, suggests Larkin, is Collier and Lakoff (2010) who examines the ways in which vulnerable critical infrastructure has become an object of knowledge for security experts and how this knowledge appears as one element in a broad-spectrum political technology of preparedness. Other examples, notes Larkin, count Armand Mattelart's examination of infrastructures as the premise of progress in political ideals of global circulation (of goods, ideas and people) (Mattelart 1997).

Thinking of infrastructures in relation to governmentality opens up to analysing them not only as spatial installations but also as 'mechanisms to control time ... instigating waves of societal progress' (Graham and Marvin 1996, 42). Indeed, many contributors urge us to think of infrastructures not only in terms of space, but also in terms of temporality. One example of this is Nikhil Anand's (2015) analysis of the accretions of infrastructures as they expand, retreat and evolve. Another is Geoffrey

Bowker's (2015) meditation on the issue of temporality in relation to infrastructure, and how this perspective allows us to appreciate the never-ending, always-in-process quality of infrastructures. The analytical emphases on infrastructures in terms of temporality and politics of rationality offer valuable insights for understanding thumbnail images as infrastructural images; firstly, it allows us to emphasize the temporality at play in the thumbnail's primary function which is to direct the user elsewhere in the fastest possible manner by harnessing the cognitive functions of visual cues and reducing loading time through image compression. Secondly, it also offers us a way of grasping the constantly unfolding, and thus inherently unstable and uncertain, infrastructure of thumbnails as they hook into, and give rise to, other emergent infrastructural configurations.

If infrastructures as logistical technologies are usually conceived of primarily in terms of function, they are also, as Brian Larkin (2013, 327–328) notes, 'semiotic and aesthetic vehicles oriented to addressees' that 'emerge out of and store within them forms of desire and fantasy' that can even take on 'fetish-like aspects that sometimes can be wholly autonomous from their technical function'. What Larkin points out is the difficulty related to separating material infrastructures from their psychic investments and imaginaries. He thus cites the Rudolf Mrázek's (2002, 166) rich descriptions of the infrastructural experience as an 'enthusiasm of the imagination' as 'stemming from the feelings of promise that technologies such as infrastructures can stimulate' (Larkin, 332). This enthusiasm, Larkin (2013, 332) argues, can ultimately be explained with Freud's identification of the basic desire for human mastery, a desire often sought fulfilled through technological augmentation to become a 'prosthetic God'. The quote from Girafa's CEO indicates that this desire might also be present in thumbnail design as the tiny images offer the user the possibility of gaining oversight through a top-

down, mastering and ‘well-’directed God-like gaze.

Uncertainties in infrastructural systems

As the previous section indicates, infrastructural systems—while often built with the purpose of providing control of, and access, to material—are also often inherently unstable and unfolding, and thus uncertain. At the most obvious level, infrastructural systems such as image search systems are haunted by the ever-present threat of infrastructural failure and breakdown: dead links, slow loading time and system failures. But other forms of uncertainties populate infrastructural systems too: financial, legal and social uncertainties: what happens to Google’s image search system if Google goes bankrupt? What if thumbnails no longer satisfy the users’ desires? To what extent do diverse jurisdictions and rules provide the legal underpinnings of image searches?

Some of these uncertainties remain threatening presences. Others are successfully turned into manageable and productive engines of innovation and creativity. Indeed, the algorithmic regimes that underlie Google’s image search infrastructures are premised on a constant negotiation between the uncertain and contingent behaviour of its users, the uncertain interpretative logics of the algorithmic ranking systems and the experimental centralized editorial acts of Google.

Indeed, as Luciana Parisi (2013, 21) points out, ‘uncertainty is at the core of the metamodeling of everyday operations of programming, designing, measuring, and calculating probabilities through digital, biodigital, and nanobiological machines’. It is therefore not by chance, she notes, that ‘the age of the algorithm’ is also recognized as ‘an age characterized by forms of emergent behavior that are determined by continual variation and uncertainty’ (Parisi 2013, 2). Algorithmic systems such as Google’s image search systems thus breed productive

uncertainty by human contingency and random computational processes (Thylstrup et al. *Forthcoming*).

Yet other infrastructural uncertainties are turned into manageable risks. One example is the way Google manages the uncertain behaviour of users. Tarleton Gillespie (2017) points to this interplay between system and users, recounting how Google has been seen to both temporarily demote commercial sites for optimizing their sites in ways Google deemed unacceptable, and remove what they deemed was offensive content, a notable example being their removal of a racist image of Michelle Obama in 2009 when it turned up as the top result for her name on Google’s image search, first the thumbnail image and later the original image. As Gillespie (2017, 70) points out,

[i]n response to criticism, Google first refused to remove it. But after continued criticism, Google delisted the image from the index, indicating on the results page that it had done so. (They later were able to remove the image from the source, as it happened to be on a blog hosted on Blogger, a Google-owned site.)

Another strident example is the way in which Google contributed to making manageable the legal uncertainties of the thumbnail through the legal doctrine of fair use. As a consequence, the multifaceted identity of the thumbnail image is pinned down conceptually as an operative image, a lower resolution logistical image that directs traffic to a higher resolution image. Within this strategic manoeuvre, no attempt is made to achieve full certainty. Rather, the legal documents leave ample speculative space as to what constitutes a thumbnail in terms of pixel count and more.

The legal uncertainty of the thumbnail image

Although a formal definition of thumbnail images was not on the industry agenda in the early years of image search, an increasingly

uncertain legal existence pushed the industry to new attempts to define it. Significantly, the industry had to secure a definition of thumbnails that would exempt it from copyright infringement cases. Google's visual infrastructure through thumbnails posed a legal conundrum: what are the criteria for the legality of a thumbnail in copyright law? Is it a legal or an illegal copy? In other words what kind of image is a thumbnail? The legal discussion came to revolve around the purpose of the thumbnail: in this way going straight to the heart of its uncertainties.

Such questions had mainly been debated in informal forums in the early years of the thumbnail. By 2007, the thumbnail image—and its attending uncertain legal status—became the centre of a United States courtroom drama: a copyright infringement case with critical implications for the future of the Internet. Essentially, the use of thumbnail images was at risk of being outlawed in the United States. Parties to the copyright infringement case included, as the defendants, the Internet titans Amazon and Google and, as the plaintiff, the adult media house Perfect10. Perfect10 claimed that Google and Amazon were infringing the copyright in their images by presenting thumbnails of them in the search engine Google Images (and a predecessor thereof). The question was if there had been what, under US copyright law, is defined as 'fair use' of Perfect10's images. For a US court of justice to decide whether a use made of a copyright work amounts to fair use it has to take four factors, defined by statute, into consideration. As defined by title 17 of United States Code, § 107, the four factors of the fair use doctrine include (1) the purpose and character of the use, including whether such use is of a commercial nature or is for non-profit educational purposes; (2) the nature of the copyrighted work; (3) the amount and substantiality of the portion used in relation to the copyrighted work as a whole; and (4) the effect of the use upon the potential market for or value of the copyrighted work.

Following a 1990 article by a leading US judge in copyright cases, Pierre N. Leval particular emphasis in the assessment of fair use came to be on the first factor. In particular, Leval introduced the notion that the degree of transformativeness in a new work was to be given the most weight in fair use analysis (Leval 1990). Thus, if a new work was significantly transformative of an original work, in terms of purpose or character, this would outweigh the other factors. Previously, in fair use analysis, courts had considered factor four to be the more important, the question of whether the new work had been made for commercial ends. Judge Leval's notion of transformativeness turned the fair use defence into a powerful legal tool in the digital domain. However, as we may note, a new certainty brought along by a more powerful fair use defence came at the expense of new uncertainties: the change in the entropy of the system became evident with the *Perfect10* ruling.

The reordering of the fair use defense radically changed the playing field of World Wide Web actors. Formerly, the situation would have been that any use, on the Internet, of an image in its entirety would require authorization from the copyright holder. This was the stance of first court in *Perfect10*. Importantly, the court of appeals overturned and rules in favour of Amazon and Google. The higher court found that 'the significantly transformative nature of Google's search engine, particularly in light of its public benefit' (*Perfect 10, Inc. v. Amazon.com, Inc. and A9.com Inc. and Google Inc.*, 508 F.3d 1146 (9th Cir. 2007) at 1164) overshadowed the fact that Google's was a superseding and commercial use of Perfect10's images. Accordingly, the high court declared that Google's thumbnails added a further purpose to the images and therefore constituted fair use. The images were not meant for contemplation in themselves: they were infrastructural images, algorithmic components that had a programming significance directing user traffic from one place to another. That is, an infrastructural capacity:

When a user clicks on a thumbnail image, the user's browser program interprets HTML instructions on Google's webpage. These HTML instructions direct the user's browser to cause a rectangular area (a 'window') to appear on the user's computer screen. The window has two separate areas of information. The browser fills the top section of the screen with information from the Google webpage, including the thumbnail image and text. The HTML instructions also give the user's browser the address of the website publisher's computer that stores the full-size version of the thumbnail. By following the HTML instructions to access the third-party webpage, the user's browser connects to the website publisher's computer, downloads the full-size image, and makes the image appear at the bottom of the window on the user's screen. Google does not store the images that fill this lower part of the window and does not communicate the images to the user; Google simply provides HTML instructions directing a user's browser to access a third-party website. (*Perfect 10, Inc. v. Amazon.com, Inc. and A9.com Inc. and Google Inc.*, 508 F.3d 1146 (9th Cir. 2007), at 1155f)

In this description, the thumbnail appears primarily as an infrastructural image consisting of a set of algorithms executed to produce a visual result. In other words, the court regarded thumbnail images as 'operative images', that is, as 'images that do not represent an object, but rather are part of an operation' as Harun Farocki has phrased it (Farocki 2004, 17). Yet, as this article also emphasizes in the following sections the representational dimension of thumbnail images is not completely lost; rather, while they are indeed parts of an operation, their visual qualities and their interplay with the human eye nevertheless also remain an important social and cultural factor of the thumbnail image.

Thumbnail images as cultural infrastructures of uncertainty

While the legal definition reduced the thumbnail image to a purely functional element in larger Web infrastructures, this section offers an infrastructural inversion of the thumbnail

image (Bowker 1994) to show the cultural dimensions of the thumbnail image in regard to wider questions of access to and availability, control and consumption of objects of desire. While the legal decision on the thumbnail image emphasized their functional purposes as operative infrastructural images, HCI literature on thumbnail images reveals that thumbnail images also possess cultural political dimensions linked to ideals of speed, overview and attraction. We focus on three key values around which thumbnail images come to be defined in HCI and related disciplinary literature: overview, preview and speed. We have two objectives. The first is to demonstrate the extent to which thumbnail images are handled as design issues. The second is to explain the implicit cultural political ideas underlying these issues and, thereby, underscore the thumbnail image as a visual marker of uncertainty, both as something to be managed and exploited.

Overview

Thumbnail images offer the user practical and mental navigational support in increasingly complex information environments by means of providing an overview (see Figure 7). As Ayers and Stasko (1995, 2) note in an article outlining ways to use graphic history when browsing,

Users of hypertext systems often find themselves eagerly following hypertext links deeper and deeper into a hypertext web, only to find themselves 'lost' in the sense that they are unable to find their way back to previously visited pages. This difficulty in revisiting previously viewed pages may discourage users from engaging in such exploratory behavior. It is hoped that the addition of the graphic history view will encourage exploratory behavior and help users navigate the WWW more easily in general.

Ayers and Stasko raise two central issues in search behaviour: the first is how to ameliorate the sense of uncertainty users experience when faced with large masses of information; the



Figure 7. Google Image (author's own image search for 'overview', accessed August 16, 2017).

second is how to support exploratory behaviour that thrives on uncertainty. These two ambitions echo in a more earthbound way the anecdote of Girafa's thrill-seeking designers that achieve overview through skydiving, and bring this ambition into their design practice.

As Sclaroff, Taycher, and La Cascia (1997) argues, the 'top-view' function of exploration (browsing) has to be complemented by interaction since interactivity is an essential feature in architectures of exploration. The top-down function of thumbnail images in image search is therefore almost always accompanied by another feature, manipulability. HCI literature frames this practice of distancing and disembodied manipulability as empowering the user. To this end, Ben Shneiderman (2003, 2) points out that information and communication technologies are most appreciated when users experience a sense of security, mastery and accomplishment, and technologies should therefore enable users to 'relax, enjoy, and explore'.

The infrastructural image of the thumbnail thus situates the user in an omnivoyant position that allows the user both to occupy an

overview position, but also enables her to manipulate the images and 'drill down' to the original image more information. While apparently benign, this connection between overview and power also has a cultural trajectory. As feminist HCI theorists remind us, the ways in which technology situates the user have a cultural dimension (D'Ignazio and Klein 2016). This reminder serves to unsettle the almost always purely positive emphasis on the empowered user in HCI literature, to remind us that to be empowered often also means having power over others. Haraway (2002, 678) offers a tour de force of the historical trajectory of this empowering visual framework, linking the contemporary situation of the user with historical examples of the deeper masculinist and colonial undertones at play in the top-down, mastering and 'well-directed' (male, god-like) image gaze,

The eyes have been used to signify a perverse capacity—honed to perfection in the history of science tied to militarism, capitalism, colonialism, and male supremacy—to distance

the knowing subject from everybody and everything in the interests of unfettered power. The instruments of visualization in multinationalist, postmodernist culture have compounded these meanings of disembodiment... Vision in this technological feast becomes unregulated gluttony ...

Thus the thumbnail image is dual-natured: it offers the user a sense of overview (and thus mastery) through its visual distancing mechanisms; yet, at the same time it also nourishes an information feast and supporting a gluttonous approach to information by seducing the user through logistical means to visit new places. Moreover, the software-generated view from above is also accompanied by a politics of uncertainty in the form of obfuscation, unreliability and displacement. This point is made by theorists such as Hito Steyerl (2012, 26), Toscano and Kinkle (2015) and Wendy Chun whom all draw on Jameson, Nelson, and Grossberg (1988) and Jameson (1996) work on cognitive mapping to offer critical perspectives on the view from above as a political mode of seeing, that nevertheless fails to empower users politically.

The view from above, and the ability to drill down, offered by the thumbnail image as an infrastructural component of image search interfaces thus link to uncertainty in two ways: firstly, while it appears as a mechanism of empowerment, and thus power, to ameliorate the user's sense of uncertainty in information-rich environments, the infrastructural image of the thumbnail nevertheless also represent an uncertain and obfuscated mode of navigation; secondly, as the next section shows, the thumbnail also plays into the desire to explore and exploit these uncertain visual territories.

Sneak peek

If HCI designers seek to offer users a sense of security and mastery through the thumbnail image's overview function that provides the user with a top-down view, they also seek to design thumbnails that facilitate the explorative

urge through preview by playing 'a similar role for an image as an abstract does for an article' (Feng et al. 2013, 194). Endowing the thumbnail with the value of a sneak peek provides it with a cultural dimension of desirability (see Figure 8). Indeed, as a group of Yahoo researchers point out, thumbnails in today's commercial visually saturated environment should thus not only be efficient, but also attractive. Especially, when it works as a form of 'advertiser' or teaser for the content from which it is derived, 'A great thumbnail ultimately makes a video more attractive to watch, which, in turn, leads to the increase in ad revenue' (Song et al. 2016, 659).

The value of attraction can work on two levels in thumbnail design. Firstly, thumbnails can function as attractive signposts that point the user to her final destination, i.e. the original image. This was also the function emphasized in the legal decision. In this case, the thumbnail is a form of advertiser for the content it points to. It promises (with the inbuilt uncertainty of promises) to lead to the desired image. The second value is less concerned with the original image, and more with creating a habit of continued exploration. Here designers aim to create thumbnail interfaces that support a steady flow of clicking, browsing and scrolling on the level of thumbnails without necessarily diving into the original images. This kind of behaviour is supported by the design of the Google Image Search interface, which is constructed in such a manner that when the user reaches the bottom of the page, she is offered an option 'show more results'. When clicked, another stream of images is unleashed, playing on the uncertainty of when and where the results may end. As behavioural designer Nir Eyal and Hoover (2014) notes in his industry-oriented book on how to hook users to their platforms, these infrastructural designs that allow the user to keep clicking, scrolling and browsing create a mental state of flows in the user where each new image functions as a reward. Thus 'as more images load on the page, the endless search for variable rewards of the hunt continues' (Eyal

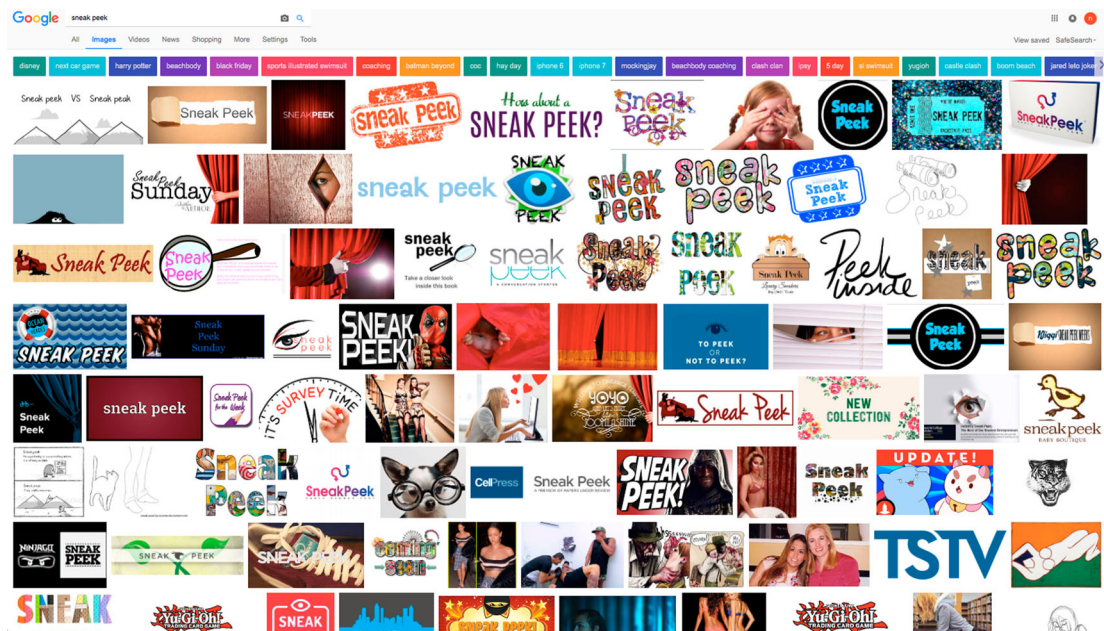


Figure 8. Google Image (author's own image search for 'sneak peek', accessed August 16, 2017).

and Hoover 2014, chapter 4). Such hunting behaviour, Natasha Dow Schüll (2014, Introduction) suggests, is less supported by rational information seeking behaviour, and more indicative of a mode of technological behaviour 'through which individuals can manage their affective states and create a personal buffer zone against the uncertainties and worries of their world'. Schüll's work opens up to showing how image search infrastructures such as Google Images themselves support, and even entice, compulsive and desirous behaviour, as well as offer themselves as tools for managing users' uncertainties in relation to the rest of the world.

Speed

If thumbnail images are designed to provide overview and sneak peek, they are also designed to offer this in a speedy manner (see Figure 9). As computer scientist Allison Woodruff et al. note on the importance of efficient thumbnails,

The user must page through lists of Web documents, briefly evaluating each for possible relevance to a particular information need.

Improving the efficiency of this tedious process directly benefits the end-user and, by improving end-user satisfaction, indirectly benefits the search engine vendor. (Woodruff et al. 2002, 1)

Within such infrastructures of speed, thumbnails play a crucial role in their capacity to improve query efficiency significantly, both because their reduced size and resolution reduce their loading time and because the human visual system processes images faster than text (Woodruff et al. 2002, 2).

The time reduction offered by the thumbnail image to the user is an inherent element in a larger commercial strategy of search engines to satisfy users' temporal needs and infrastructural demands. As noted in an article in Search Engine Land on 24 May 2016, Internet users spend a significant amount of time examining search engine results with Google alone accounting for almost 60,000 queries per second in 2016 and more than two trillions searchers that year. Among HCI designers, and related branches of computer sciences, reducing task completion therefore

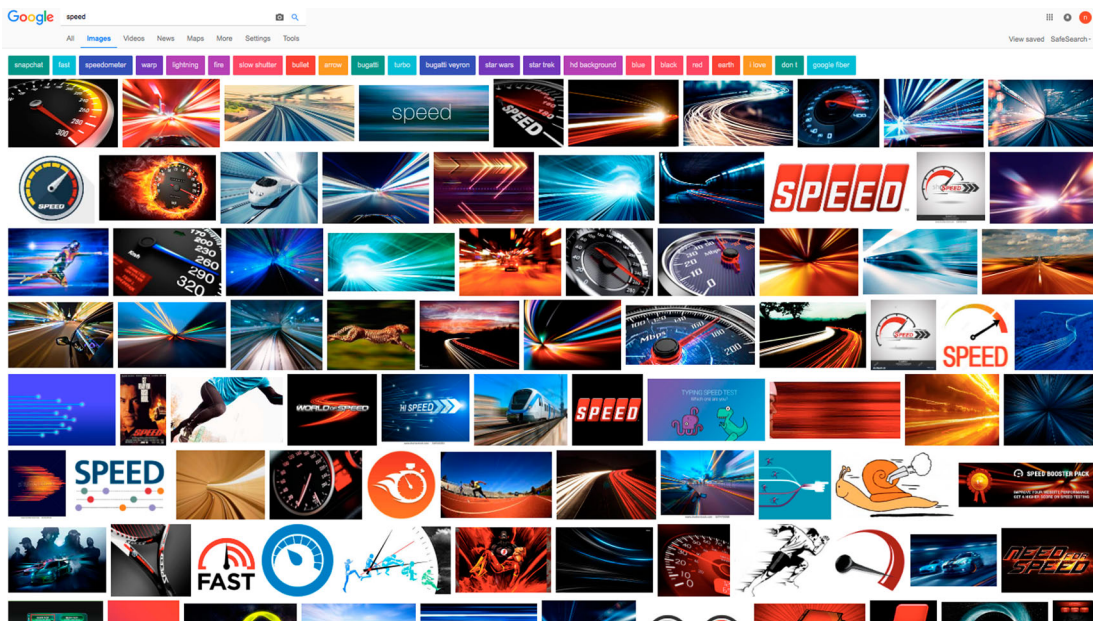


Figure 9. Google Image (author's own image search for 'speed', accessed August 16, 2017).

represents a central value. Since quantity is one indicator of Google's success, infrastructural speed facilitates a significant growth of information: the more queries the user can perform, the more traffic the system facilitates and the more information it feeds to the companies who in turn use this to showcase how many percentages of the internet statistical landscape they take up and how much attention they master. In this marketplace of attention, where users expect real-time service and minimum response time, the thumbnail image has become one instrument among many to accelerate search practices while also catching and retaining the attention of the user. However, it is a double-edged sword. To the user, subject quantity will inevitably be linked with a sense of uncertainty: vast numbers of search results will come with the feeling of never being able to get to the bottom of things. But, as we have also noted, this uncertainty not only generates states of apathy, but can also be titillating and creating a user response of desirous engagement.

That speed is a crucial component of computational infrastructures which is also

emphasized by Lilly Irani in her article on the infrastructures of crowdsourcing (2015, 7) which points out that speed has both a symbolic and practical dimension in computer science: symbolic to the point that

even after 10 years in business and many revisions to their search results page, each Google search still proudly announces that its, say, 35 million results were found in just 0.23 seconds'; practical, because speedy interaction makes interactions seem continuous and smooth. In design circles 'good' design therefore equals immediate and manipulable technologies 'that are worked through, not on'.

As search interfaces promise the ability to provide increased overview, sneak peek and efficiency, so do the tasks, and thus cultural dimensions, of the thumbnail image increase.

This section has described the socio-cultural dimensions of the thumbnail image that are sustained by the values of image search infrastructures. HCI designers and related areas of computer science imbue thumbnail images and their infrastructures with cultural values beyond those of mere logistical functions.

Thumbnail images comprise elements of a style of visual management, offering users expanded agency to act upon the world of images in the World Wide Web. In this world, the thumbnail straddles and moves uncertainly between the infrastructural binaries set out in the legal description of the thumbnail image as a 'surface' image that points to a 'deeper' original. Here, it responds to issues of uncertainty, ameliorating the uncertainty of users who are faced with large quantities of information, while also supporting explorative, desirous and sometimes even compulsory, behaviour that thrives on this uncertainty.

Conclusion

As district judge Howard Matz noted, the 'principal two-part issue' of the licit nature of thumbnail images

arises out of the increasingly recurring conflict between intellectual property rights on the one hand and the dazzling capacity of internet technology to assemble, organize, store, access and display intellectual property 'content' on the other hand. That issue, in a nutshell, is: does a search engine infringe copyrighted images when it displays them on an 'image search' function in the form of 'thumbnails'? (*Perfect 10 v. Google, Inc.*, 416 F.Supp.2d 828 (United States District Court, C.D. California 2006)).

The appreciation of the thumbnail image as an infrastructural image in a cultural as much as a functional understanding allows us to see that the process of image compression does not strip thumbnails of cultural and aesthetic value. Rather, thumbnail images by being uncertain in themselves offer the user situated ways of dealing with, and giving into, two forms of World Wide Web uncertainties: the uncertainty of information overload and the uncertainty of desire.

Thumbnail images are thus infrastructural images that offer logistical functions, but do so in ways that also offer promises of plenitude, attraction and mastery. In hindsight, it therefore

makes perfect sense that the seminal decision on thumbnails in *Google v. Perfect10* was centred on thumbnails of adult content. The producers of adult content are well aware that their users are not necessarily concerned with the original high-resolution images, but often also appreciate low-resolution images and infrastructures of plenitude. Challenging Google's description of the thumbnail as mere infrastructure, the plaintiff Perfect10 thus argued that the thumbnails were valuable in and of themselves. Indeed, even the court admitted as much when they noted that 'Google's use of thumbnails likely does harm the potential market for the downloading of [Perfect10's] reduced-size images onto cell phones' (*Perfect 10, Inc. v. Amazon.com, Inc. and A9.com Inc. and Google Inc.*, 508 F.3d 1146 (9th Cir. 2007), 1165).

Yet, the infrastructures of image search are constructed around thumbnail images as fair use. Thus, it was clear that recognizing the thumbnail image as anything other than an operative image would significantly challenge the infrastructure of the World Wide Web. The outcome was that the thumbnail's cultural values were reduced to an identity that was only about logistics. But we have also seen that the thumbnail continues its affective existence despite—or rather because of—this legal decision. The status and role of the thumbnail in digital environments thus shows us the ways in which visual infrastructures such as thumbnail images are implemented in constant negotiation with existing infrastructures, user desires, corporate considerations and contemporary beliefs about the limits and potentials of visual perception. Indeed, what is so striking about the thumbnail and what makes them particularly interesting in this era of technical infrastructures and computational promises of empowerment are the ways in which they inherently display many of the characteristics of infrastructures *tout court*: on the one hand, quietly and discreetly attracting, directing and sustaining user traffic while

also allowing them to feel empowered. On the other hand, at the infrastructural breach of legal intervention, emerging as crucial elements in today's information environments imbued with cultural values that go beyond mere logistics.

Note

1. *Kelly v. Arriba Soft Corporation*, 336 F.3d 811 (9th Cir. 2003).

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